

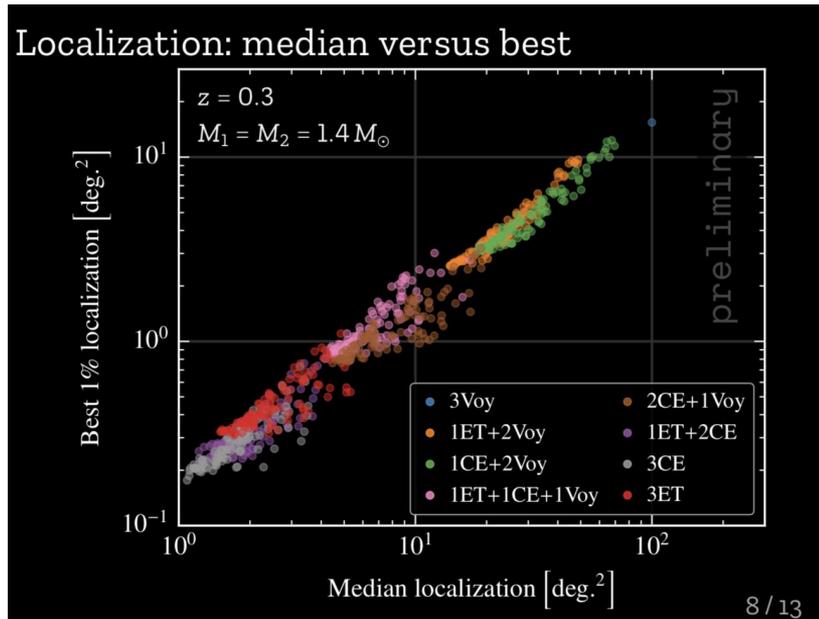
# Summary of Session 3: Challenges

Stefan Ballmer & Laura Cadonati

# Astrophysics -- 3G performance metrics (Hall)

What should a network of 3G detectors look like?

- Where, how many, how long, optical design



Preliminary Conclusion:

- It mostly doesn't matter what percentile events you optimize for
- A 2G facility isn't a replacement for a 3G facility no matter how clever you are with your network
- New science is already gained from adding 1 3G detector to a 2.5G network

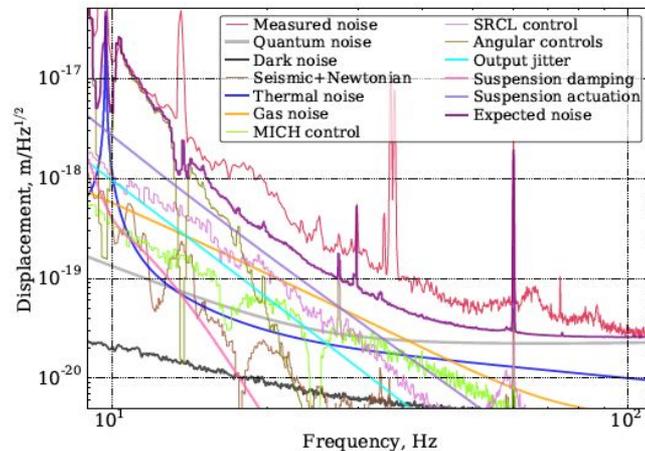
**A paper / technical note with these results, with specific science cases for different configurations / timeline of turning on facilities.**

# Trade of science gained at low frequencies vs. Observatory requirements (Hild+Ballmer)

Low frequencies allow access to higher mass mergers, binary parameters, early warning, etc,

But: Numerous challenges (Newtonian, control, scatter noise, etc; cost of underground, large suspensions etc.).

**Need relevant low frequency prototypes, but hard to come by.**  
**Use combination of existing detectors and prototypes specific LF noise sources**



# Roadmap between A+ and 3G (Zucker+McClelland)

Large-scale engineering demo projects expensive but needed to demonstrate 3G technology

- **Need to break down all risky problems into pieces and show we can solve each one of the separately.**
  - Various options: current detectors as prototypes, room for mid-scale prototypes (like LASTI), some compact test beds, etc
  - Common in DOE to have up to 10% of cost for Technology demonstration

What is the impact of A+ AdV, Voyager etc on 3G network planning?

**This scope (astrophysics and technical need for instruments between 2025-2035) should have a task team to identify one or more coherent paths for the community**



## A few questions for the 'Voyager Epoch'



- how long will A+/AdV+ be interesting for observing
- what cost scales are involved in making another 1.5-2x improvement in the instruments
- when do those costs fall on funding agencies wrt to the CE/ET costs
- what roles do these 2.5-2.75 generation play for CE/ET in terms of risk-reduction prototypes
- what level of constructive and destructive interference will these projects have on parallel demands to get ET/CE designed/fabbed
- do we want to deploy one of the world network instruments as a 2.75G system as a test, or multiple ones to increase the network sensitivity

# Coatings -- roadmap to readiness (Fejer)

Typical Requirements

	T (K)	$\lambda$ ( $\mu\text{m}$ )	$\phi / \phi_{\text{a-LIGO}}$	HR abs.
A+	300	1	1/4	0.5 ppm
Voyager	123	~2	1/4	2 ppm
ET-LF	10 – 20?	1.5?	1/3	~1-5 ppm

- Explorer:
  - A+ or Voyager coating solution can be applied though larger optics and higher power
- No magic bullet solution meets all requirements
  - brief view of physics to motivate approaches
- Present examples of representative approaches

- Timeline: about 2 years left for A+ coatings, >5 years for cryo (Voyager, etc)
- Tooling limitations: right now only LMA
  - Coatings get big interest from industry, but on small scales only
- Lots of progress, measurements - but repeatability is an issue
- Not quite a roadmap but a winding way: the fog is starting to lift

**Need to be ready to invest in tooling for scaling-up coating technology when adequate coating becomes available.**

# Computing requirements (Porter)

- GW data analysis will become more difficult and demanding
  - Storage will become an issue
  - Performance will be an issue depending on how low-latency we want to be
- It may require an investment in computing that frees up the scientists to do science
- Traditionally, GW computing only looked at searches and parameter estimation, but the scope of 3G computing is broader, and should include things like making the model waveforms.
  
- **Quantify how needs will change with high rate of high SNR events**
- **Hardware: task force to investigate new technology and cost/benefit analysis (think before jumping)**
- **Software: investigation and benchmarking of new methods - cost/benefit analysis**
- **Continue working with NR community (good at opportunistically taking advantage of technology developments and working around limitations)**
- **Funding for professional coding (personpower), and more generally delivery of data to the public, needs to be incorporated in 3G planning**